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# Spectroscopic and time-resolved measurements of the fluorescence of pyrene at low temperatures for noble liquid particle detectors

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Pyrene is an interesting material because of its wavelength shifting properties. When irradiated with ultraviolet light, pyrene will emit light in the visible wavelengths. This property could be useful for experiments looking to observe scintillation light from noble gases such as argon and neon, which are popular target materials for dark matter direct detection experiments. Noble gases scintillate in the ultraviolet, and wavelength shifting materials are used to generate visible light observable with standard light detectors. These noble gas detectors are usually operated at cryogenic temperatures, so the performance of pyrene as a wavelength shifter at low temperatures is relevant to its use in such experiments. Relatively long fluorescence lifetime of pyrene provides a possibility to use pulse shape discrimination for rejection of backgrounds caused by alpha activity in regions of the detector where light collection is poor.

We have studied the light emission of pyrene under ultraviolet light excitation at Queen's University using an optical cryostat down to 3.4 K. The high vapour pressure of pyrene causes thin films to evaporate when exposed to the vacuum required to achieve colder temperatures, so we have developed samples of acrylic with dissolved pyrene to prevent the loss of material. Photomultiplier tubes combined with the multiple photon-counting coincidence (MPCC) method allow us to extract the time structure of pyrene fluorescence in response to nanosecond pulses of vacuum ultraviolet light. We also use a spectrometer to measure the wavelength spectra of the emitted light at multiple temperatures to understand its performance. We present the results of both time-resolved and spectroscopic studies of pyrene dissolved in acrylic at low temperatures, including those of noble liquids.

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